

What is claimed is:

1. An article of manufacture comprising a metal substrate and a coating in contact with the metal substrate, wherein the coating comprises:
 - (1) linearly conjugated π -systems;
 - (2) residues of sulfonated lignin or a sulfonated polyflavonoid or derivatives of sulfonated lignin or a sulfonated polyflavonoid; and
 - (3) a film-forming resin.
2. The article of claim 1 wherein the derivatives comprise one or more hydroxy, methoxy, ethoxy, hydroxymethyl, or 2-hydroxyethoxy substituents;
3. The article of claim 1 wherein the residues are of sulfonated lignin or a sulfonated polyflavonoid.
4. The article of claim 1 wherein the linearly conjugated π -systems comprise repeating monomer units of aniline, thiophene, pyrrole, or phenyl mercaptan, wherein the repeating monomer units of aniline, thiophene, pyrrole, or phenyl mercaptan are optionally ring-substituted with one or more straight or branched alkyl, alkoxy, or alkoxyalkyl groups.
5. The article of claim 1 wherein the linearly conjugated π -systems comprise polyanilines.
6. The article of claim 1 wherein the linearly conjugated π -systems comprise polypyrroles or polythiophenes.
7. The article of claim 1 wherein the linearly conjugated π -systems comprise repeating monomer units selected from the group consisting of aniline, o-ethylaniline, m-ethylaniline, o-ethoxyaniline, m-buthylaniline, m-hexylaniline, m-

octylaniline, 4-bromoaniline, 2-bromoaniline, 3-bromoaniline, 3-acetamidoaniline, 4-acetamidoaniline, 5-chloro-2-methoxyaniline, 5-chloro-2-ethoxyaniline, 2,5-dimethylaniline, 2,3-dimethylaniline, 2,5-dibutylaniline, 2,5-dimethoxyaniline, tetrahydronaphthylamine, 2-cyanoaniline, 2-thiomethylaniline, 3-(n-butanesulfonic acid)aniline, 2,4-dimethoxyaniline, 4-mercaptoaniline, 4-methylthioaniline, 3-phenoxyaniline, 4-phenoxyaniline, thiophene, pyrrole, and thiophenol.

8. The article of claim 1 wherein the linearly conjugated π -systems are grafted to the residues.

9. The article of claim 1 wherein the film-forming resin is selected from the group consisting of polyurethanes, epoxies, neutral resins, acidic resins, acrylics, polyesters, glycidyl acrylates, polyamides, polyimides, polyaramids, polycarbonates, polymethyl methacrylates, poly(amide-imides), polyvinyl fluorides, urea-formaldehyde, phenol-formaldehyde, melamine-formaldehyde and combinations thereof.

10. The article of claim 1 wherein the film-forming resin comprises an acrylic resin and a melamine formaldehyde resin.

11. The article of claim 1 wherein the film-forming resin is a water-borne resin.

12. The article of claim 1 wherein the film-forming resin is an organic-solvent-borne resin.

13. The article of claim 1 wherein the coating composition is a high solids formulation.

14. The article of claim 1 wherein the coating composition is UV radiation curable.

15. The article of claim 1 wherein the coating composition is a powder coating formulation.
16. The article of claim 1 wherein the coating composition comprises sulfonated lignin.
17. The article of claim 1 wherein the coating composition comprises sulfonated lignin and the linearly conjugated π -systems comprise polyanilines.
18. A latex formulation comprising: (a) linearly conjugated π -systems, (b) residues of sulfonated lignin or a sulfonated polyflavonoid or derivatives of sulfonated lignin or a sulfonated polyflavonoid; and (c) a film-forming resin.
19. The composition of claim 18 wherein the latex is a water-based latex.
20. The composition of claim 18 wherein the derivatives comprise one or more hydroxy, methoxy, ethoxy, hydroxymethyl, or 2-hydroxyethoxy substituents;
21. The composition of claim 18 wherein the residues are of sulfonated lignin or a sulfonated polyflavonoid.
22. The composition of claim 18 wherein the linearly conjugated π -systems comprise repeating monomer units of aniline, thiophene, pyrrole, or phenyl mercaptan, wherein the repeating monomer units of aniline, thiophene, pyrrole, or phenyl mercaptan are optionally ring-substituted with one or more straight or branched alkyl, alkoxy, or alkoxyalkyl groups.

23. The composition of claim 18 wherein the linearly conjugated π -systems comprise polyanilines.
24. The composition of claim 18 wherein the linearly conjugated π -systems comprise polypyrroles or polythiophenes.
25. The composition of claim 18 wherein the linearly conjugated π -systems comprise repeating monomer units selected from the group consisting of aniline, o-ethylaniline, m-ethylaniline, o-ethoxyaniline, m-butyraniline, m-hexylaniline, m-octylaniline, 4-bromoaniline, 2-bromoaniline, 3-bromoaniline, 3-acetamidoaniline, 4-acetamidoaniline, 5-chloro-2-methoxyaniline, 5-chloro-2-ethoxyaniline, 2,5-dimethylaniline, 2,3-dimethylaniline, 2,5-dibutyraniline, 2,5-dimethoxyaniline, tetrahydronaphthylamine, 2-cyanoaniline, 2-thiomethylaniline, 3-(n-butanesulfonic acid)aniline, 2,4-dimethoxyaniline, 4-mercaptoaniline, 4-methylthioaniline, 3-phenoxyaniline, 4-phenoxyaniline, thiophene, pyrrole, and thiophenol.
26. The composition of claim 18 wherein the linearly conjugated π -systems are grafted to the residues.
27. The composition of claim 18 wherein the film-forming resin is selected from the group consisting of polyurethanes, epoxies, neutral resins, acidic resins, acrylics, polyesters, glycidyl acrylates, polyamides, polyimides, polyaramids, polycarbonates, polymethyl methacrylates, poly(amide-imides), polyvinyl fluorides, urea-formaldehyde, phenol-formaldehyde, melamine-formaldehyde and combinations thereof.
28. The composition of claim 18 wherein the film-forming resin comprises an acrylic resin and a melamine formaldehyde resin.

29. The composition of claim 18 wherein the film-forming resin is a water-borne resin.

30. The composition of claim 18 wherein the film-forming resin is an organic-solvent-borne resin.

31. The composition of claim 18 wherein the coating composition is a high solids formulation.

32. The composition of claim 18 wherein the coating composition is UV radiation curable.

33. The composition of claim 18 wherein the coating composition is a powder coating formulation.

34. The composition of claim 18 wherein the coating composition comprises sulfonated lignin.

35. The composition of claim 18 wherein the coating composition comprises sulfonated lignin and the linearly conjugated π -systems comprise polyanilines.

36. A composition for coating a metal, comprising: (a) linearly conjugated π -systems, (b) residues of sulfonated lignin or a sulfonated polyflavonoid or derivatives of sulfonated lignin or a sulfonated polyflavonoid; and (c) a film-forming resin other than a formaldehyde-based resin.

37. The composition of claim 36 wherein the film-forming resin comprises an acrylic resin.

38. The composition of claim 36 wherein the film-forming resin comprises an acrylic resin and a melamine formaldehyde resin.
39. The composition of claim 36 wherein the derivatives comprise one or more hydroxy, methoxy, ethoxy, hydroxymethyl, or 2-hydroxyethoxy substituents.
40. The composition of claim 36 wherein the residues are of sulfonated lignin or a sulfonated polyflavonoid.
41. The composition of claim 36 wherein the linearly conjugated π -systems comprise repeating monomer units of aniline, thiophene, pyrrole, or phenyl mercaptan, wherein the repeating monomer units of aniline, thiophene, pyrrole, or phenyl mercaptan are optionally ring-substituted with one or more straight or branched alkyl, alkoxy, or alkoxyalkyl groups.
42. The composition of claim 36 wherein the linearly conjugated π -systems comprise polyanilines.
43. The composition of claim 36 wherein the linearly conjugated π -systems comprise polypyrroles or polythiophenes.
44. The composition of claim 36 wherein the linearly conjugated π -systems comprise repeating monomer units selected from the group consisting of aniline, o-ethylaniline, m-ethylaniline, o-ethoxyaniline, m-butylianiline, m-hexylaniline, m-octylaniline, 4-bromoaniline, 2-bromoaniline, 3-bromoaniline, 3-acetamidoaniline, 4-acetamidoaniline, 5-chloro-2-methoxyaniline, 5-chloro-2-ethoxyaniline, 2,5-dimethylaniline, 2,3-dimethylaniline, 2,5-dibutylianiline, 2,5-dimethoxyaniline, tetrahydronaphthylamine, 2-cyanoaniline, 2-thiomethylaniline, 3-(n-butanesulfonic

acid)aniline, 2,4-dimethoxyaniline, 4-mercaptoaniline, 4-methylthioaniline, 3-phenoxyaniline, 4-phenoxyaniline, thiophene, pyrrole, and thiophenol.

45. The composition of claim 36 wherein the linearly conjugated π -systems are grafted to the residues.

46. The composition of claim 36 wherein the film-forming resin is selected from the group consisting of polyurethanes, epoxies, neutral resins, acidic resins, acrylics, polyesters, glycidyl acrylates, polyamides, polyimides, polyaramids, polycarbonates, polymethyl methacrylates, poly(amide-imides), polyvinyl fluorides, urea-formaldehyde, phenol-formaldehyde, melamine-formaldehyde and combinations thereof.

47. The composition of claim 36 wherein the film-forming resin comprises an acrylic resin and a melamine formaldehyde resin.

48. The composition of claim 36 wherein the film-forming resin is a water-borne resin.

49. The composition of claim 36 wherein the film-forming resin is an organic-solvent-borne resin.

50. The composition of claim 36 wherein the coating composition is a high solids formulation.

51. The composition of claim 36 wherein the coating composition is UV radiation curable.

52. The composition of claim 36 wherein the coating composition is a powder coating formulation.

53. The composition of claim 36 wherein the coating composition comprises sulfonated lignin.

54. The composition of claim 36 wherein the coating composition comprises sulfonated lignin and the linearly conjugated π -systems comprise polyanilines.

55. A method of protecting a metallic substrate from corrosion comprising:
(1) contacting the substrate with a coating composition comprising: (a) linearly conjugated π -systems, (b) residues of sulfonated lignin or a sulfonated polyflavonoid or derivatives of sulfonated lignin or a sulfonated polyflavonoid; and (c) a film-forming resin; and
(2) curing the coating composition to form a corrosion resistant coating on the substrate.

56. The method of claim 55 wherein the derivatives contain one or more hydroxy, methoxy, ethoxy, hydroxymethyl, or 2-hydroxyethoxy substituents.

57. The method of claim 55 wherein the residues are of sulfonated lignin or a sulfonated polyflavonoid.

58. The method of claim 55 further comprising preparing a surface of the metallic substrate for adhesion to the coating composition.

59. The method of claim 55 wherein the linearly conjugated π -systems comprise repeating monomer units of aniline, thiophene, pyrrole, or phenyl mercaptan, wherein the repeating monomer units of aniline, thiophene, pyrrole, or phenyl mercaptan are optionally ring-substituted with one or more straight or branched alkyl, alkoxy, or alkoxyalkyl groups.

60. The method of claim 55 wherein the linearly conjugated π -systems comprise polyanilines.
61. The method of claim 55 wherein the linearly conjugated π -systems comprise polypyrroles or polythiophenes.
62. The method of claim 55 wherein the linearly conjugated π -systems comprise repeating monomer units selected from the group consisting of aniline, o-ethylaniline, m-ethylaniline, o-ethoxyaniline, m-butyylaniline, m-hexyylaniline, m-octyylaniline, 4-bromoaniline, 2-bromoaniline, 3-bromoaniline, 3-acetamidoaniline, 4-acetamidoaniline, 5-chloro-2-methoxyaniline, 5-chloro-2-ethoxyaniline, 2,5-dimethylaniline, 2,3-dimethylaniline, 2,5-dibutyylaniline, 2,5-dimethoxyaniline, tetrahydronaphthylamine, 2-cyanoaniline, 2-thiomethylaniline, 3-(n-butanesulfonic acid)aniline, 2,4-dimethoxyaniline, 4-mercaptoaniline, 4-methylthioaniline, 3-phenoxyaniline, 4-phenoxyaniline, thiophene, pyrrole, and thiophenol.
63. The method of claim 55 wherein the linearly conjugated π -systems are grafted to the residues.
64. The method of claim 55 wherein the coating composition comprises sulfonated lignin.
65. The method of claim 55 wherein the coating composition comprises sulfonated lignin and the linearly conjugated π -systems comprise polyanilines.
66. The method of claim 55 wherein the film-forming resin is selected from the group consisting of polyurethanes, epoxies, neutral resins, acidic resins, acrylics, polyesters, glycidyl acrylates, polyamides, polyimides, polyaramids,

polycarbonates, polymethyl methacrylates, poly(amide-imides), polyvinyl fluorides, urea-formaldehyde, phenol-formaldehyde, melamine-formaldehyde and combinations thereof.

67. The method of claim 55 wherein the film-forming resin comprises an acrylic resin and a melamine formaldehyde resin.

68. The method of claim 55 wherein the film-forming resin is a water-borne resin.

69. The method of claim 55 wherein the film-forming resin is an organic-solvent-borne resin.

70. The method of claim 55 wherein the coating composition is a high solids formulation.

71. The method of claim 55 wherein the coating composition is UV radiation curable.

72. The method of claim 55 wherein the coating composition is a powder coating formulation.

73. The method of claim 55 wherein the coating composition is a water-based latex.